CANADIAN PETROLEUM ASSOCIATION

PIPELINE DIVISION

OIL PIPELINE PERFORMANCE REVIEW

1989

- TECHNICAL COMMITTEE -

OIL PIPELINE PERFORMANCE REVIEW SUBCOMMITTEE

A.G. Horne	- Chairman
M.J. Massecar	- Member
W.B. Masson	- Member
W.W. Scott	- Member
S.P. Rodrigues	- CPA Statistician
I.F. Scott	- CPA Liaison

CANADIAN PETROLEUM ASSOCIATION
1989 OIL PIPELINE PERFORMANCE REVIEW

TABLE OF CONTENTS

			PAGE
EXECUTIVE SUMMARY			i
1.0 INTRODUCTION			1
2.0 PERFORMANCE REVIEW			3
2.1	1989 Summary		3
2.2	1989 vs 1988 Highlights		3
2.3	Historical Review		4
3.0 FAILURE SUMMARY			6
3.1	Highlights		6
3.2	1989 vs Ten Year Average		7
APPENDICES			
A	Failure Details		10
B	CPA Report Forms	- General Data Report	15
		- Failure Report	16
C	1989 OPPR Participants		17

LIST OF EXHIBITS

	PAGE
EXHIBIT 1 - Summary of 1989 Failures	Executive Summary
EXHIBIT 2 - Historical Summary of Failures	Executive Summary
EXHIBIT 3 - Scope	2
EXHIBIT 4 - Statistical Summary	5
EXHIBIT 5 - List of Failures by Category	8
EXHIBIT 6 - 1989 Failure Statistics	9

1989 OIL PIPELINE PERFORMANCE REVIEW

EXECUTIVE SUMMARY

A. GENERAL OVERVIEW

- The number of failures increased 29.4% from 34 in 1988 to 44 in 1989. The previous 10-year average is 42 failures per year.
- The volume spilled increased from 1224 m^3 to 5490 m^3. The 10-year average is 5605 m^3.
- Repair, damage, and clean-up costs were slightly above 1988 at $1,771,000.
- One injury occurred associated with an HVP equipment failure.
- One failure reported without any supporting data has been included in the total of 44 failures. However, because of impending litigation, no further information has been made available. Consequently, all statistical data in the remainder of this report is based on the 43 failures for which complete data is available.

B. 1989 HIGHLIGHTS

i) Performance

- In-service length of reporting systems increased from 33 856 km in 1988 to 34 493 km in 1989.
- Deliveries decreased 4% to 233 X 10^6 m^3 in 1989 compared to 1988.
- Traffic volume decreased less than 1% compared to 1988.

ii) Failures

- A total of 44 failures were reported.
- Five failures occurred in HVP systems.
- Thirty-seven failures were detected by employees and third parties on site.
- Six failures were detected by some method of leak detection.
- 1989 failures resulted in one fire and one injury. There were no explosions or fatalities.

EXHIBIT 1

1989 OIL PIPELINE PERFORMANCE REVIEW
SUMMARY OF FAILURES

CANADIAN PETROLEUM ASSOCIATION

1989 OIL PIPELINE PERFORMANCE REVIEW
SUMMARY OF FAILURES

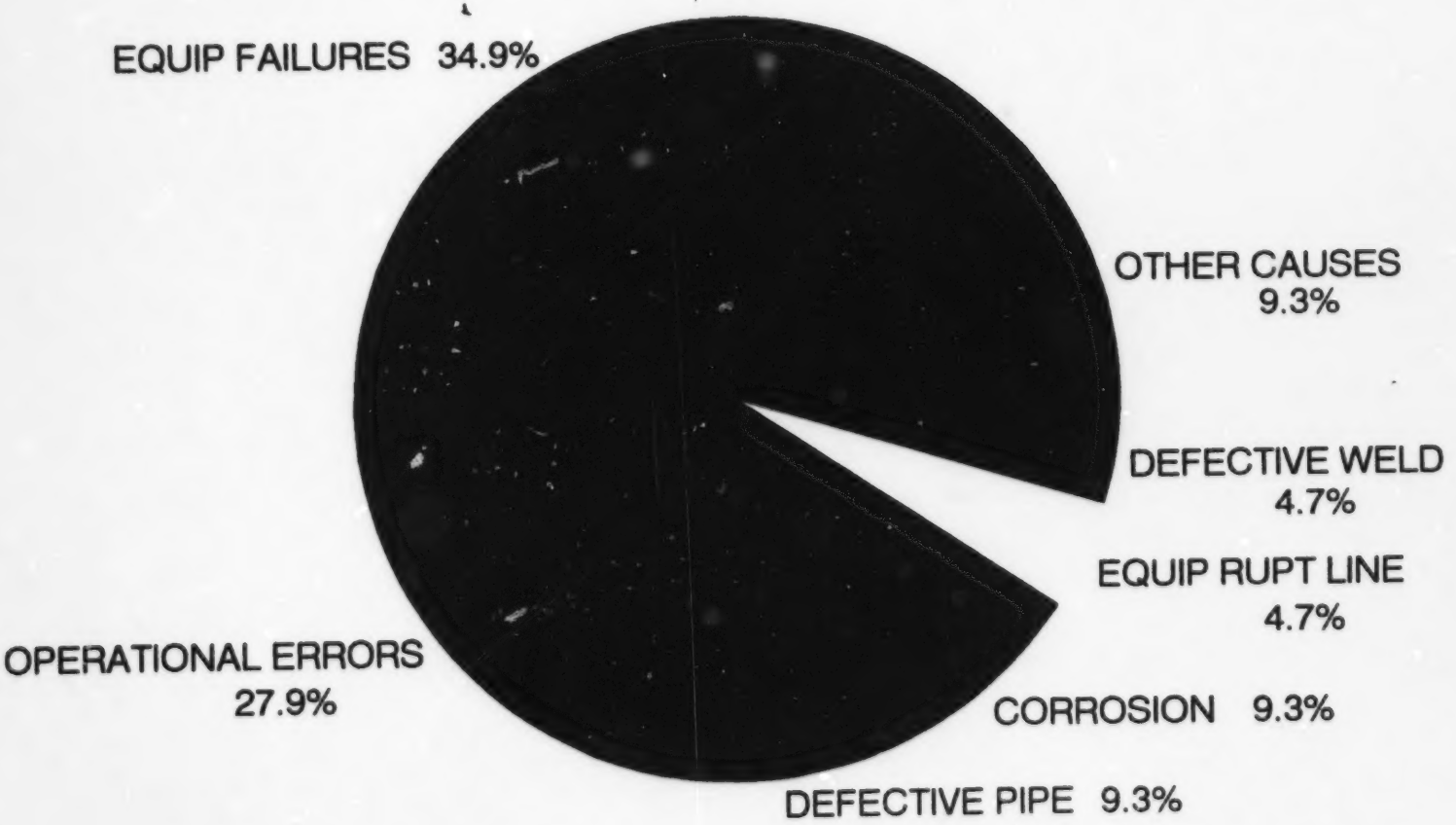
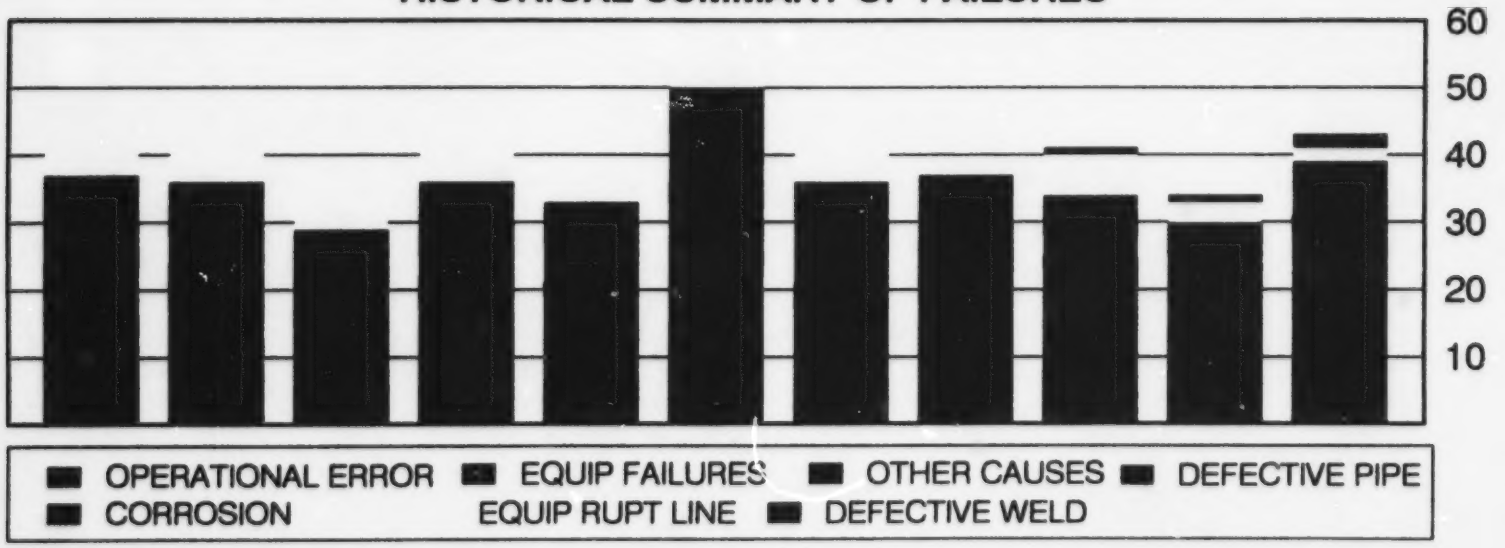


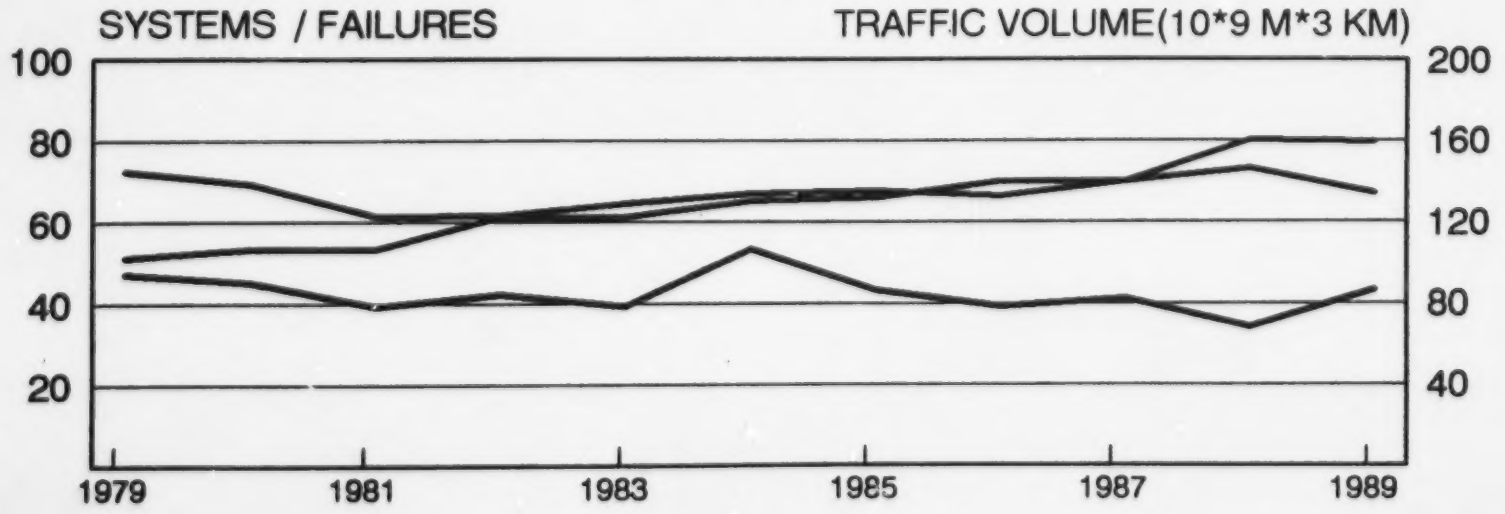
EXHIBIT 2

1989 OIL PIPELINE PERFORMANCE REVIEW
HISTORICAL SUMMARY OF FAILURES

1989 OIL PIPELINE PERFORMANCE REVIEW

HISTORICAL SUMMARY OF FAILURES





CANADIAN PETROLEUM ASSOCIATION

1989 OIL PIPELINE PERFORMANCE REVIEW

1.0 INTRODUCTION

All liquid hydrocarbon pipelines in Canada, including crude oil, refined products and high vapour pressure (HVP) lines are requested to participate in this industry analysis by submitting voluntary, confidential performance and failure reports. The majority of these pipeline systems are represented by the Canadian Petroleum Association (CPA).

Pipelines included in this review fall within the scope of CAN3-Z183-M86, Oil Pipeline Transportation Systems. However, only oil lines and high vapour pressure pipelines downstream of production facilities and refined petroleum product lines are covered. Multi phase lines, producer operated pipelines and flow lines now included in CAN3-Z183-M86 are not covered. This scope is shown diagrammatically in Exhibit 3.

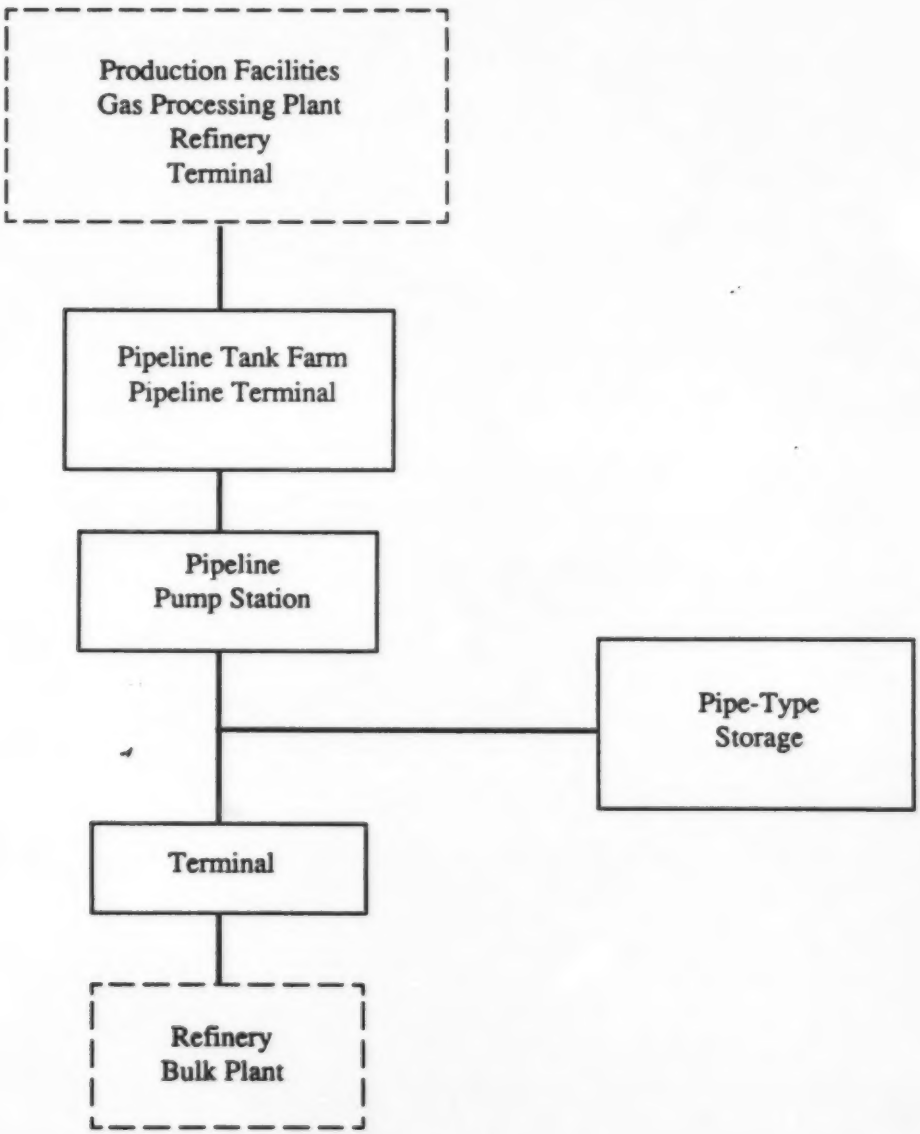
All data for the review was collected by CPA on two standard forms. Samples of the Oil Pipeline General Data Report and the Oil Pipeline Failure Report are included in Appendix B. Incidents resulting in a spill of 1.5 m^3 or more of oil, or any amount of HVP material, and any incident involving an injury, a death, a fire, or an explosion are classified as reportable.

Care must be exercised in any attempt to apply or compare statistics included in this review to any particular pipeline system or regulatory jurisdiction. They have been generated on the basis of submissions from a wide variety of pipelines, including gathering systems.

EXHIBIT 3

CANADIAN PETROLEUM ASSOCIATION

1989 OIL PIPELINE PERFORMANCE REVIEW SCOPE



NOTE: Only facilities and pipelines indicated by solid lines are within scope of CPA - Oil Pipeline Performance Review.

2.0 PERFORMANCE REVIEW

Sixty-nine participating Canadian oil pipeline systems submitted reports. This represents the majority of the industry and includes all major oil pipeline systems. The statistics in this review are, therefore, considered representative of the industry.

2.1 1989 SUMMARY

One fire and one injury were reported. No fatalities or explosions were associated with the reported incidents.

The average spill size was 128 m^3 in 1989, considerably greater than the average of 36 m^3 in 1988.

Length of line in service increased 1.9% while deliveries and traffic volumes were down from 1988.

Six of the 43 incidents reported were detected by some form of leak detection system.

Two of the failures in 1989 can be attributed to third party damage.

HVP leaks accounted for 11% of the total volume released.

Defective pipe accounted for four failures in 1989 - equal to the previous 10-year average.

2.2 1989 VS 1988 HIGHLIGHTS

A comparison of key results is provided in the table below:

	1989	1988	% Change
No. of Pipeline Systems Reporting	69	73	-5.5
Length of Line In-Service - km	34493	33856	+1.9
Delivery Volume X 10^6 m^3	233	243	-4.2
Traffic Volume X 10^9 m^3/km	159	160	-0.6
No. of Failures	43	34	+26.5
Volume spilled - m^3	5490	1224	+348.5
Repair, Damage & Clean-up Costs - k$	1771	1768	+ 0.2
Injuries	1	0	-
Deaths	0	0	-

2.3 HISTORICAL REVIEW

An 11-year statistical summary of oil pipeline performance data is presented in Exhibit 4.

Key observations and highlights compared with the previous 10-year average are:

- Clean-up and repair costs are up.
- Length of line in service, total delivery volume, and total traffic volume are all up.
- The number of failures is up slightly.
- The total volume spilled is down slightly.
- One injury and no fatalities were reported.

A comparison of key results is provided in the table below.

	1989	Previous Ten-Year Average	% Change
Pipeline Systems Reporting	69	62	+11.3
Length of Line In-Service - km	34493	31147	+10.7
Delivery Volume X 10^6 m^3	233	223	+4.4
Traffic Volume X 10^9 m^3/km	159	136	+17.3
No. of Failures	43	42	+2.4
Volume spilled - m^3	5490	5605	-2.1
Repair/Clean-up Costs - k$	1771	1459	+21.4
Injuries	1	1.9	-47.4
Deaths	0	0.3	-

EXHIBIT 4

CANADIAN PETROLEUM ASSOCIATION
1989 OIL PIPELINE PERFORMANCE REVIEW STATISTICAL SUMMARY

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	10-Year Average	1989
Number of Pipeline Systems Reporting	51	53	53	61	61	65	66	70	70	73	62	69
Length of Line in Service - km	29678	29785	29650	30308	30439	30615	30905	32617	33621	33856	31147	34493
Delivery Volume $X 10^6 m^3$	245.4	235.7	214.9	211.6	204.4	215.3	211.6	219.0	230.5	243.2	223.0	232.9
Traffic Volume, $X 10^9 m^3/km$	144.8	138.5	122.6	123.1	128.7	134.1	135.0	132.6	140.0	160.1	136.0	159.5
Number of Failures	47	45	39	42	39	53	43	39	41	34	42	43
Failures/10^3 km	1.6	1.5	1.3	1.4	1.3	1.7	1.4	1.2	1.2	1.0	1.3	1.2
Failures/10^9 m^3 km	0.32	0.33	0.33	0.34	0.30	0.39	0.32	0.29	0.29	0.21	0.31	0.30
Volume Spilled - m^3	7014	8511	2377	6537	7450	6171	10738	2055	3977	1224	5605	5490
Volume Loss - m^3	2614	5931	1427	3531	6038	2982	7830	654	3154	496	3466	1846
Average Spill Size - m^3	149	189	61	156	196	116	250	53	97	36	133	128
Largest spill Size - m^3	1987	6061	516	1365	1589	1994	3800	320	2800	284	6061	3136
Injuries Resulting from Failures	1	0	0	2	4	2	5	4	1	0	1.9	1
Deaths Resulting from Failures	0	0	0	0	1	0	2	0	0	0	0.3	0
Repair, Damage and Spill Clean-up Costs k$ **	1611	1254	634	1320	2721	953	2533	794	1005	1768	1459	1771

* Not all volumes move total system length.
** Does not include cost of product lost due to failure.

3.0 FAILURE SUMMARY

3.1 HIGHLIGHTS

Twenty-two of the 69 participating pipeline systems reported a total of 43 failures in 1989. The number of failures reported for 1989 are up from the 34 failures reported in 1988, and one more than the 10 year average of 42. Failures were distributed as follows:

Thirteen Systems	-	1 Failure
Six Systems	-	2 Failures
Three Systems	-	3 Failures
One System	-	9 Failures

Exhibit 5 provides a summary of 1989 failure categories.

Exhibit 6 provides additional details for each failure category. There was one fire and an injury associated with an HVP pipeline facility in 1989. There were no explosions associated with the failures reported in 1989.

Forty percent of the failures were detected by pipeline employees, 46% by outside parties and 14% by surveillance and leak detection systems*.

* For the purpose of this report the definition of surveillance and leak detection systems includes material balance systems, and/or any other mechanical or electronic means which would detect the possibility of a leak and initiate a response.

3.2 1989 VS TEN YEAR AVERAGE

SUMMARY OF FAILURES

	1989	Previous 10 Year Average
Equipment Failures	15	13
Equipment Rupturing Line	2	6
Corrosion - Internal	3	7
- External	1	-
Operational Error	12	8
Defective Pipe	4	4
Defective Weld	2	<1
Natural Hazard	1	<1
Other	3	4
TOTAL	43	42

EXHIBIT 5

CANADIAN PETROLEUM ASSOCIATION
1989 OIL PIPELINE PERFORMANCE REVIEW
LIST OF FAILURES BY CATEGORY

	LVP	HVP	TOTAL
EQUIPMENT FAILURES			
Gasket	2	-	2
Fittings	4	-	4
Packing	2	-	2
Bushing	0	1	1
Switch	1	-	1
Tank Floor	1	-	1
Freezer Plug	1	-	1
Valves	1	-	1
Strainer	1	-	1
Tubing	-	1	1
	13	2	15
EQUIPMENT RUPTURING LINE			
Contract Equipment	2	-	2
CORROSION			
External	1	-	1
Internal	3	-	3
	4	0	4
OPERATIONAL ERROR			
Valve not Closed	3	-	3
Overfilling	5	-	5
Miscellaneous	1	-	1
Overpressure Piping	3	-	3
	12	0	12
DEFECTIVE PIPE	2	2	4
DEFECTIVE WELD			
Fillet Weld	1	1	2
OTHER			
Natural Hazard	1	-	1
Pipe Previously Damaged	2	-	2
Other	1	-	1
	4	0	4
TOTAL	38	5	43

EXHIBIT 6

CANADIAN PETROLEUM ASSOCIATION
1989 OIL PIPELINE PERFORMANCE REVIEW STATISTICAL SUMMARY

	EQUIPMENT FAILURE	EQUIPMENT RUPTURING LINE	CORROSION EXTERNAL	CORROSION INTERNAL	OPERATIONAL ERROR	DEFECTIVE PIPE	DEFECTIVE WELDS	OTHER	TOTAL
NUMBER OF FAILURES	15	2	1	3	12	4	2	4	43
Failure Location									
- Line Pipe	1	2	1	3	3	4	1	3	18
- Pump Station	7	-	-	-	3	-	1	-	11
- Tank Farm	3	-	-	-	3	-	-	-	6
- Delivery Point	4	-	-	-	3	-	-	1	8
Detection Method									
- Outside Party	7	1	-	2	4	1	1	4	20
- Pipeline Employee	8	-	-	1	5	2	1	-	17
- R.O.W. Surveillance	-	-	-	-	-	-	-	-	0
- Leak Detection	-	1	1	-	3	1	-	-	6
Failure Impact									
- Injuries	1	-	-	-	-	-	-	-	1
- Fires	1	-	-	-	-	-	-	-	1
- Explosions	-	-	-	-	-	-	-	-	0
- Area Damaged (Hectares)	2.5	0.7	1.2	1.2	2.3	2.4	-	0.2	10.5
- Costs (K$)*	279	404	390	77	66	404	63	88	1771
- Clean-Up Time (Days)	42	10	50	10	43	13	6	11	185
- Shutdown Time (Days)	5.4	3.3	3	2	2.7	7	2.5	3.4	29.3
Spill Volume (m^3)									
- Released	343	96	234	738	233	3755	24	68	5490
- Reclaimed	250	63	120	146	178	2799	24	65	3645
- Lost	93	33	114	592	55	956	0	3	1846
Commodity Released									
- Crude Oil	12	2	1	2	9	1	1	3	31
- Condensate	-	-	-	1	3	1	-	-	5
- Refined Products	1	-	-	-	-	-	-	1	2
- HVP	2	-	-	-	-	2	1	-	5

* Repair, Damage, and Clean-Up Costs only

APPENDIX A

CANADIAN PETROLEUM ASSOCIATION
1989 OIL PIPELINE PERFORMANCE REVIEW
FAILURE DETAILS

Failures have been arranged into six categories as indicated in Exhibits 4, 5, and 6. Details of each failure category are as follows:

1. EQUIPMENT FAILURE

This category accounted for 15 (35%) of the failures in 1989, an increase of five when compared to the 10 year average. There was one fire and injury associated with an HVP facility failure. A total of 343 m^3 was released with about 93 m^3 lost.

Threaded nipples accounted for four failures, while leaking valves caused four others.

One incident was responsible for 27% of the liquid released in this category.

The three most significant failures are highlighted as follows:

i) A threaded bushing failed in the drain piping from a block valve, releasing 12 m^3 of ethane. A fire resulted from this failure and a pipeline employee was injured.

ii) A gasket on a pig trap failed and caused 94 m^3 of crude to spill. 84 m^3 of this product was recovered.

iii) A screwed nipple failed, and 70 m^3 of crude oil was released of which 23 m^3 was lost.

2. EQUIPMENT RUPTURING LINE

There were two failures in this category in 1989 which is four less than the 10-year average.

One failure occurred as a result of an excavation by a contractor working on another pipeline adjacent to the pipeline which was struck. This failure resulted in the release of 80 m^3 of crude, which represented 83% of the volume released in this category.

The other failure was a result of excavation activities within the limits of a block valve assembly. 16 m^3 of crude oil was released, of which 13 m^3 was recovered.

3. CORROSION

External

There was one leak due to external corrosion during 1989.

Internal

Internal corrosion accounted for three failures compared to one in the previous year. A total of 738 m^3 of crude oil was released. One of the failures accounted for 83% of the released product.

Two leaks occurred at the 6 o'clock position in the line pipe.

The three internal corrosion failures for 1989 was four less than the 10- year average.

4. OPERATIONAL ERROR

There were 12 incidents of operational error that resulted in the release of 233 m^3 (55 m^3 lost). This frequency of operational error is four more than the previous year, and four more than the ten-year average.

i) Three incidents of valves not being closed resulted in the release of 64 m^3 (2.5 m^3 lost).

ii) There were five incidents of sump tanks being over-filled. A total of 19 m^3 was released (2 m^3 lost).

iii) One incident involved the off loading of trucked volumes of crude. A total of 3 m^3 was spilled.

iv) 147 m^3 of crude was released as a result of dresser couplings being over pressured. Three incidents were recorded in this category.

5. DEFECTIVE WELDS

There were two defective welds that resulted in 24 m3 of product being released. The cause of one failure was a crack in a girth weld of a tee. The other failure involved an HVP pipeline and occurred on a cracked weld found in a repair clamp.

6. DEFECTIVE PIPE

There were four failures due to defective longitudinal seams in line pipe. Three of the incidents involved failures of the seam weld while the other one was found to be a cracked seam weld.

A total of 3755 m^3 of product was released (955 m^3 lost), which accounted for 63% of the total 1989 spill volume.

Two of the failures involved an HVP pipeline.

7. OTHER

There were four failures attributed to other causes which accounted for 1% of the total volume spilled.

Two of the failures that occurred were due to pipe previously damaged, releasing a total of 57 m^3 (2 m^3 lost). Both of these incidents were a result of the pipe failing at a dent in the pipe. One operator determined that the damage was caused by a third party. The other operator was unable to establish the cause of the damage.

One incident was a result of a crack at a buckle in the pipe. A geo-technical investigation revealed that the buckle had been caused by an unstable slope that had shifted causing the buckle. The other incident was the result of frost heave on a 19 mm instrumentation line that led to a fracture at an elbow.

APPENDIX B

OIL PIPELINE GENERAL DATA REPORT

OIL PIPELINE FAILURE REPORT

OIL PIPELINE GENERAL DATA REPORT

CANADIAN PETROLEUM ASSOCIATION

YEAR 19

PIPELINE COMPANY OR SYSTEM

Name.....

Address.....

.....

INSTRUCTION

1. This report is for clean oil onshore pipeline systems covered by CSA Standard Z183 - Oil Pipeline Transportation Systems.
2. A separate report should be made for each operating pipeline system and forwarded to CPA within 30 days of each year end.
3. Reports by CPA member companies must be completed or reviewed for completeness by CPA Technical Committee or Pipeline Division member.

FAILURE

Number of Reportable Failures during recording calendar year: (A failure report must be submitted for each reportable failure) .....

VOLUME DATA

Volume of oil transported during year -LVP.....m^3

-HVP.....m^3

Volume - Distance during year -LVP.....m^3km

-HVP.....m^3km

GENERAL SYSTEM DATA

	LENGTH (km)	NUMBER OF STATIONS	NUMBER OF PUMPS	INSTALLED POWER (kW)	STORAGE (M^3)
Mainline	.....	.....	.....	.....	.....
Gathering	.....	.....	.....	.....	.....
Total	.....	.....	.....	.....	.....

Total number of full time employees: .....

REPORTED BY

Name..... Date Completed.....

Title..... Telephone number.....

CPA* MEMBER

Name..... Date Checked.....

*If applicable.

Mail to:
CANADIAN PETROLEUM ASSOCIATION
3800, 150 SIXTH AVENUE S.W.
CALGARY, ALBERTA
T2P 3Y7

Revision 02/90

OIL PIPELINE FAILURE REPORT

CANADIAN PETROLEUM ASSOCIATION

Sheet.....of .....

PIPELINE COMPANY OR SYSTEM

Name.....

Address.....

.....

INSTRUCTIONS

1. This report is for pipeline systems covered by CSA Standard Z183 -- Oil Pipeline Transportation Systems. All data on this form will be kept confidential in accordance with request in "USE OF DATA" section.
2. A separate report should be made out for each failure and forwarded to CPA as soon as possible, but not later than 60 days after the failure.
3. A reportable failure is one in which 1.5m³ or more of oil are released; OR one in which any High Vapour Pressure (HVP) material is released; OR one in which there is an injury, a death, a fire, or an explosion. Failures during controlled testing, when using oil as the test medium, should be reported in accordance with these guidelines.
4. Zone location questions apply only to failures involving HVPs.
5. Reports by CPA member companies must be completed or reviewed for completeness by CPA Technical Committee or Pipeline Division Member.
6. Property damage costs reported under Failure Impact will be reported excluding product loss.

NOTE

Please complete all appropriate sections including "Written Account of Failure" using Typewriter or Black Ink.

GENERAL INFORMATION

Date of Failure

Year	Month	Day	Time (24 hr.)
			:

Commodity Released

Volume Information - Cubic Metres

Released		Recovered		Lost
	=		+	

Province: .....

Nearest town: .....

Area type: ☐ Urban ☐ Rural

Spill was on: ☐ Land ☐ Water

Terrain type: .....

Zone location if applicable: ☐ Zone 1 ☐ Zone 2 Installation year of failed component 19

☐ Line Pipe ☐ Pump Station ☐ Tank Farm ☐ Delivery Point

MAJOR CAUSE OF SPILL

Please check one only:

☐ Internal corrosion ☐ Defective pipe ☐ Equipment rupturing line

☐ External corrosion ☐ Defective weld ☐ Pipe previously damaged

☐ Operational error ☐ Equipment failure ☐ Natural hazard

☐ Other (specify): .....

ORIGIN OF SPILL

Please check as many items as required:

☐ Pipe ☐ Scraper trap ☐ Valve ☐ Meter

☐ Seam weld ☐ Welded fitting ☐ Pump ☐ Prover

☐ Girth weld ☐ Bolted fitting ☐ Tank ☐ Strainer

☐ Other (specify): .....

CANADIAN PETROLEUM ASSOCIATION
1989 OIL PIPELINE PERFORMANCE REVIEW

PARTICIPATING PIPELINE OPERATORS AND COMPANIES

ALBERTA ENERGY COMPANY LTD.

- Alberta Oil Sands Pipeline
- Cold Lake Bitumen Blend
- Cold Lake Diluent Line
- Redwater Pipeline

AMOCO CANADA PETROLEUM COMPANY LTD.

- Alberta Ethane Gathering System Ltd.
- Aurora Pipe Line Company
- Cochin Pipe Lines Limited
- Amoco Cochrane - Edmonton Pipeline
- Empress - Kerrobert Pipeline
- Rangeland Pipe Line Company
- NGL Pipeline Ltd. (EDS North)

BP RESOURCES CANADA LIMITED

- Chauvin Pipeline
- Red Earth

ESSO PETROLEUM CANADA

- Quebec South Shore Pipe Line
- Sarnia Products Pipe Line
- Winnipeg Pipeline Company Limited

ESSO PETROLEUM CANADA - IMPERIAL PIPELINE COMPANY LIMITED

- Excelsior/Fairydell Crude System
- Leduc Crude System
- Acheson/Golden Spike System
- Redwater Propane System
- Alberta Butane System
- Edmonton-Sundre Crude Line
- Judy Creek Condensate PipeLine
- Nisku Products Pipeline Company Limited

ESSO RESOURCES CANADA

- Rimbey to Edmonton System
- Bonnie Glen System
- Green River System
- Quirk Creek System

GULF CANADA RESOURCES LIMITED

- Wabasca River Pipeline

HOME OIL COMPANY LIMITED

- Cremona Pipe Line Division
- Federated Crude System
- Federated NGL System
- Manyberries Pipe Line

HUSKY OIL OPERATIONS LTD.

INTERPROVINCIAL PIPE LINE COMPANY

INTERPROVINCIAL PIPE LINE COMPANY (NW)

MOBIL OIL CANADA

- Rainbow Pipe Line Company Ltd.
- South Saskatchewan Pipe Line Company

MONTREAL PIPE LINE LIMITED

MURPHY OIL COMPANY LTD.

- Bodo Pipeline
- Cactus Lake Pipeline
- Milk River Pipeline
- Wascana Pipeline Ltd.
- Manito Pipelines Ltd.

NORCEN ENERGY RESOURCES LIMITED

- Manitoba Pipeline
- B.C. Pipeline
- Joarcam
- Saskatchewan Pipeline
- Golden Pipeline

NOVA CORP CHEMICAL LTD.

- Alberta Gas Ethylene

PEACE PIPE LINE LTD.

PEMBINA CORPORATION

PETRO-CANADA PRODUCTS

- Alberta Products Pipe Line Ltd.
- Gulf Alberta Pipeline
- Fort Saskatchewan Pipeline
- Rimbey Pipeline Company Ltd.
- Saskatoon Pipeline
- Valley Pipe Line

PETRO-CANADA RESOURCES

- Petroleum Transmission Company

PRODUCERS PIPELINE INC.

- Producers/Westspur Pipeline

SUN-CANADIAN PIPE LINE COMPANY LIMITED

SUN PIPE LINE COMPANY

SUNCOR INC.

- Blueberry Taylor Pipeline
- Ft. McMurray to Edmonton Oil Pipeline

TRANS MOUNTAIN PIPE LINE COMPANY LTD.

TRANS-NORTHERN PIPELINES INC.

UNOCAL CANADA LIMITED

WESTCOAST PETROLEUM LTD.